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ABSTRACT TITLE: Analysis and Simulation of the Ultrasonic/Sonic Driller/Corer (USDC)

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ABSTRACT TEXT

An ultrasonic/sonic driller/corer (USDC) was developed to address the challenges to the NASA objective of planetary in-situ rock sampling and analysis. The USDC uses a novel drive mechanism, transferring ultrasonic vibration into an impact on a drill stem at sonic frequency using a free-flying mass block (free-mass). The main parts of the device and the interactions between them were analyzed and numerically modeled to understand the drive mechanism and allow design of effective drilling mechanism. A computer program was developed to simulate the operation of the USDC and successfully predicted the characteristic behavior of the new device. This paper covers the theory, the analytical models and the algorithms that were developed and the predicted results.

KEYWORDS: Ultrasonic/sonic driller/corer (USDC), in-situ sampling, ultrasonic drilling, planetary exploration, piezoelectric devices, Active Materials.

BRIEF BIOGRAPHY: Dr. Xiaoqi Bao is a Member of the Engineering Staff at the NDE and Advanced Actuators (NDEAA) team of the Jet Propulsion Laboratory. He joined JPL in May 1997 after serving for about ten years as a Research Associate at Pennsylvania State University. He received his Ph. D., Physics, in 1985 and M. Sc., Physics, in 1982 from the Chinese Academy of Sciences, Beijing, China. In 1986, Dr. Bao was a Visiting Scientist at the Dept. of Electrical Engineering of Toyama University, Japan. He has research experience in actuators, composite materials, piezoelectric motors, SAW sensors, active vibration and sound control, and intelligent materials/structures. He has published more than 30 papers in related research areas.